STATE OF MINNESOTA DISTRICT COURT
COUNTY OF RAMSEY SECOND JUDICIAL DISTRICT

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The State of Minnesota,
by Hubert H. Humphrey, III,
its attorney general,
and
Blue Cross and Blue Shield
of Minnesota,

Plaintiffs,

vs. File No. C1-94-8565

Philip Morris Incorporated, R.J.
Reynolds Tobacco Company, Brown
& Williamson Tobacco Corporation,
B.A.T. Industries P.L.C., Lorillard
Tobacco Company, The American
Tobacco Company, Liggett Group, Inc.,
The Council for Tobacco Research-U.S.A.,
Inc., and The Tobacco Institute, Inc.,

Defendants.

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TRANSCRIPT OF PROCEEDINGS
VOLUME 49, PAGES 9645 - 9763
MARCH 27, 1998

P R O C E E D I N G S.

THE CLERK: All rise, Ramsey County District Court is again in session, the Honorable Kenneth J. Fitzpatrick now presiding.

(Jury enters the courtroom.)

THE CLERK: Please be seated.

THE COURT: Good morning.

(Collective "Good morning.")

THE COURT: Counsel.

MR. GARNICK: Good morning, Your Honor. We call Kathleen Harty by deposition. She is a former employee of the state of Minnesota. We call her pursuant to Rule 611(c) as a former employee of an adverse party.

(Videotape played.)

MS. NELSON: Your Honor, plaintiffs would object to page 50, line 18, through page 51, line seven, for reasons raised at the side-bar several days ago with regard to this court's order.

MR. GARNICK: Your Honor, could we have a side-bar on this? I don't think it implicates the earlier day's side-bar.

THE COURT: Okay.

(Side-bar discussion as follows:)

(Side-bar discussion concluded.)

(Videotape continued to be played.)
MR. GARNICK: For clarification, we're continuing on on page 64, line 24.
(Videotape continued to be played.)
MR. GARNICK: The following portion refers to Defendants' Exhibit 226, which is Trial Exhibit BYS000066, which are minutes from the Technical Advisory Committee dated December 14, 1983, and we

would offer them into evidence at this time.
MS. NELSON: No objection, Your Honor.
THE COURT: They'll be received into evidence.
(Videotape continued to be played.)
MR. GARNICK: The following passage refers to Exhibit No. 229 for the deposition, and that is a portion of The Minnesota Plan on Smoking and Health, which was admitted -- it's already admitted into evidence as BYB000274.
(Videotape continued to be played.)
MS. NELSON: Your Honor, we would object to the testimony at page 308, line 16, to 309, line six, on the grounds previously mentioned.
MR. GARNICK: We oppose on the grounds previously mentioned.
THE COURT: Those questions and answers may

be given.
(Videotape continued to be played.)
MR. GARNICK: The following passage is Deposition Exhibit 865, which is Trial Exhibit BYS000233. It's a memorandum from Kathy Harty to Dick Welch on the history of non-smoking budget cuts, and we would offer it into evidence.
MS. NELSON: No objection, Your Honor.
THE COURT: Court will receive BYS000233.
(Videotape continued to be played.)
MR. GARNICK: Your Honor, the next passage refers to Deposition Exhibit 866, which is Trial Exhibit BYS000163, that is a May 29, 1992 memo from Kathy Harty to Dick Welch, director, "Effect on Section for Non-Smoking and Health of additional budget reductions of $57,569 for FY," fiscal year, "1993," and we offer it into evidence.
MS. NELSON: No objection, Your Honor.
THE COURT: Court will receive BYS000163.
(Videotape continued to be played.)
MS. NELSON: Your Honor, plaintiffs object to the testimony from page 541, line 19, through 542, line 11, on grounds of lack of foundation, Rule 402, and the issues raised at the side-bar several days ago.

MR. GARNICK: Your Honor, defendants --
THE COURT: Can you hold off? I've got to get to the next volume here. Give me the page again, please.
MS. NELSON: Yes. It's volume three, and it's page 541, line 19, through page 542, line 11.
THE COURT: The objection is sustained.
MS. NELSON: And Your Honor, we need to turn to page 556, line five, to 557, line 12, on the same basis.
MR. GARNICK: And we oppose on the same basis for reasons stated at the side-bar.
THE COURT: The objection is sustained.

(Videotape continued to be played.)
MS. NELSON: Your Honor, plaintiffs would object to the testimony on page 723, line 10 through 24, on the same basis.
MR. GARNICK: Defendants oppose on the same basis for reasons stated at the side-bar, given the limited nature of the inquiry.
THE COURT: Those questions and answers may be given.
(Videotape continued to be played.)
(Mr. Garnick gestures to video technician.)
THE COURT: Counsel, counsel, I don't think

that's proper. I don't want repetition on the deposition unless you seek the permission of the court.
MR. GARNICK: I apologize, Your Honor. The deposition -- the question was started halfway through it, and I was just seeking to get the whole question read. I apologize.
THE COURT: Whenever you repeat the deposition, please ask the permission of the court.
MR. GARNICK: I apologize to the court.
THE COURT: Okay.
MR. GARNICK: May we go back and replay the entire question?
THE COURT: No. It's been played twice. Get to the next question.
MR. GARNICK: All right.
(Videotape continued to be played.)
MR. GARNICK: Your Honor, we're having some technical difficulties with the sound.
THE COURT: Do you want to take a short recess?
MR. GARNICK: That would be good.
THE COURT: Maybe you can get it straightened out.
THE CLERK: Court stands in recess.

(Recess taken.)
THE CLERK: All rise. Court is again in session.
(Jury enters the courtroom.)
THE CLERK: Please be seated.
THE COURT: I wish to announce that, in particular in order to accommodate those persons who are from out of town on the Easter Passover weekend, we will recess at noon on Friday and trial will reconvene at noon on Monday.
Counsel.
MR. GARNICK: Your Honor, we have not been able to fix the problem with the sound, so with the court's permission we'd like to read the remainder of the deposition, it's not very long, with myself reading the questions and Ann Walker reading the answers.
THE COURT: We aren't going to hear from

Mr. Ciresi this time?
(Laughter.)
THE COURT: Go ahead, counsel. Can you start us off at a page, please?
MR. GARNICK: Yes, Your Honor, page 764, line eleven.
(Deposition read in lieu of continuing to

play the videotape.)
MR. GARNICK: Your Honor, at this time, the next passage refers to Deposition Exhibit 1554, which is Trial Exhibit BYS000457, and that is an article in Tobacco Control by Kathleen Harty entitled "Animals and butts: Minnesota's media campaign against tobacco," and we offer it into evidence.
MS. NELSON: No objection, Your Honor.
THE COURT: Okay. Court will receive BY -- BYS000457.
(Deposition continued to be read.)
MR. GARNICK: Your Honor, that concludes the designations from the Harty deposition.
Defendants next call Andrew Dean, another former employee of the state of Minnesota, by deposition, pursuant to Rule 611(c).
(Videotape played.)
MR. GARNICK: The next passage makes reference to Plaintiffs' Exhibit 226, which is Trial Exhibit BYS000066, which is already introduced into evidence.
(Videotape continued to be played.)
MR. GARNICK: The next passage, Your Honor, refers to Exhibit 918, which is a copy of a document already introduced into evidence as BYB000274.

(Videotape continues to be played.)
MS. NELSON: Your Honor, plaintiffs object to the testimony at page 264, line 14 through 20, the question and answer, on the grounds there's no foundation and that it calls for speculation.
MR. GARNICK: We oppose for -- on the basis that we set out in the side-bar, Your Honor.
THE COURT: Okay, the objection is sustained.
(Videotape continued to be played.)
THE COURT: Counsel, I just sustained that objection.
MR. GARNICK: I understand that, Your Honor, and I apologize for that.
THE COURT: It's sustained from line 14 to line 20, the question and answer.
(Videotape continued to be played.)
MR. GARNICK: Your Honor, the next portion refers to Deposition Exhibit 1552, which is Trial Exhibit BYS000103, which is an article authored by Andrew Dean and others published in Public Health Reports in 1986, and we move it into evidence.
MS. NELSON: No objection, Your Honor.

THE COURT: Court will receive BYS000103.
(Videotape continued to be played.)

MR. GARNICK: Your Honor, that concludes the deposition.
THE COURT: We will recess --
MS. NELSON: Excuse me.
MR. GARNICK: Oh.
THE COURT: Sorry.
MS. NELSON: Your Honor, I would like to introduce Trial Exhibit 26133, which is the errata sheet from this deposition.
THE COURT: Okay.
MR. GARNICK: No objection.
THE COURT: All right. That will be received.
We'll recess and reconvene at 2:15.
THE CLERK: Court stands in recess to reconvene at 2:15.
(Recess taken.)

(In-chambers conference as follows:)

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(In-chambers discussion concluded.)

AFTERNOON SESSION.

THE CLERK: All rise. Ramsey County District Court is again in session.

(Jury enters the courtroom.)

THE CLERK: Please be seated.

THE COURT: Counsel.

MR. WEBER: Thank you, Your Honor. Am I on? Yes.

Thank you, Your Honor. Thank you.

The defendants call as a witness Dr. David E. Townsend.

(Witness sworn.)

THE CLERK: Please state your name and spell your last name.

THE WITNESS: My David is David E. Townsend, T-o-w-n-s-e-n-d.

THE CLERK: Thank you. Please have a seat.

DAVID E. TOWNSEND

called as a witness, being first duly sworn, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. WEBER:

Q. Good afternoon, Dr. Townsend.

A. Good afternoon.

MR. WEBER: Good afternoon, ladies and gentlemen.

(Collective "Good afternoon.")

Q. Dr. Townsend, would you tell the ladies and gentlemen of the jury where you're employed.

A. Yes. I'm employed at R. J. Reynolds Tobacco Company.
Q. And what's your current position at R. J. Reynolds?
A. Right now I'm vice-president of product development and assessment.
Q. How long have you been employed at R. J. Reynolds, Dr. Townsend?
A. I've been with Reynolds for just a little over 20 years.
Q. Now for how much of that 20 years, Dr. Townsend, have you been directly involved in the research, design, and development of cigarettes?
A. For the entire 20 years that I've been at Reynolds my duties have been involved in -- in cigarette design or product development. I've been involved in some very basic research and trying to understand how cigarettes work, I've also been involved in very applied product development. So it spans the entire range, but my entire 20 years has

been devoted to cigarette design.
Q. Dr. Townsend, are you aware that I informed this jury on opening statement that you would come here to discuss with them the issues of cigarette design and the efforts of R. J. Reynolds and others to modify and reduce tar and nicotine deliveries of cigarettes?
A. Yes, I'm aware of that.
Q. Are you prepared today to discuss the facts and matters you've learned through study and experience as a 20-year employee in the R. J. Reynolds research and development department?
A. I am prepared to do that.
Q. Are you also prepared to discuss the issues, whether R. J. Reynolds and its U.S. competitors have provided smokers with a range of products that sought to address the theories and suggestions about cigarette design that have been raised by the scientific community over the past 40 years?
A. Yes.
Q. Are you also prepared to discuss whether anyone, other than Reynolds and its competitors, have developed feasible alternative designs for cigarettes that can be proven to be superior to those which Reynolds and its competitors have on the market?
MR. CIRESI: Objection, there's no

foundation for this witness to testify to that, Your Honor.
THE COURT: Well he can answer that. You'll have to lay a foundation later I assume.
A. I am prepared to speak to that.
Q. Before we get into the substance of these and other issues, doctor, I want to go into your background in some more detail so that the ladies and gentlemen of the jury will understand the background you have in cigarette research and design -- and

design.
But first, would you the jury a little bit where you grew up and about your wife and your family.
A. Well I was born in Kansas City, Missouri, and at a very early age by family moved to North Carolina, first to a small town named Hickory, and I suppose I spent most of my early childhood in Charlelotte, North Carolina. Grew up in Charlotte, North Carolina, and then left there only when I went to the university.
Q. When did you get married?
A. I was married in 1967. I've been -- in fact just celebrated my 30th anniversary.
Q. Okay. And do you have children?
A. I have two daughters. Both are grown. My

oldest daughter is now 25; the youngest daughter is going to be 21 in several weeks.
Q. Where did you attend college, doctor?
A. I did undergraduate work at the University of North Carolina at Chapel Hill. Spent four years there studying chemistry.
Q. And your degree was in?
A. I got a bachelor of science degree in chemistry.
Q. Did you go on, then, to do graduate studies?
A. I did. I left Chapel Hill and then went to Florida State University in Tallahassee, Florida, and received a master of science degree in physical/organic chemistry in 1972 and a Ph.D. degree in physical/organic chemistry in 1974.
Q. What is physical/organic chemistry, doctor?
A. Well there are different branches of chemistry, like physical chemistry, organic chemistry, analytical chemistry. Physical/organic chemistry is the combination of two of those important branches.
Organic molecules -- or organic chemistry is a study of organic molecules that contain carbon and hydrogen, and physical chemistry is the study of physical aspects of molecules. So physical/organic chemistry is combining the two, and a typical physical/organic chemist may try to understand the

shapes of molecules, how molecules react with one another so try to understand the detailed mechanisms of these reactions, how particular properties of -- of the -- of the compound or chemical might influence those reaction rates. So a physical/organic chemist, for example in my case, studied the rates of reactions and particularly under -- tried to understand the various steps that molecules undergo in going through a reaction.
Q. To receive your Ph.D. from Florida State University, did you complete a thesis?
A. Oh, yes, I did.
Q. And what was the subject of your thesis?
A. Well the general subject of all my graduate work, both for masters and for the Ph.D. degree, was

in the area photochemistry reactions, and there -- those are reactions that are induced by shining light, either visible or ultraviolet light on reactions which can then start that reaction occurring. And in particular, I was trying to understand the mechanisms or how these reactions occur between compounds that we call dienes and compounds that we call polycyclic aromatic hydrocarbons. So I was essentially trying to understand the mechanisms of

polycyclic-aromatic-hydrocarbon addition to these dienes when light is shined on those molecules.

Q. Did any of your graduate work at Florida State result in the publication of your research in the peer-review literature?

A. It did. There were a number of papers published in a variety of peer-reviewed journals.

Q. After you received your doctorate from Florida State in 1974, doctor, what did you do?

A. In the fall of 1974 I left Florida State University, after I finished, and went to Philadelphia where I took a job with Rohm & Haas Chemical Company. Rohm & Haas was a manufacturer of plastics and polymers, and my job at Rohm & Haas was in -- in an area we call process research, trying to understand better ways to make polymers and monomers.

Rohm & Haas, for example, makes plexiglass, and part of my job was to try to develop processes for -- for manufacturing the building blocks of this plexiglass, the monomers that would then undergo polymerization reactions to ultimately form plexiglass. Also was involved in a number of specialty coatings, like for automobile finishes, paints and the like.

Q. And then you joined R. J. Reynolds in 1977?

A. I did. I came to R. J. Reynolds in Winston-Salem, North Carolina, in October of 1977.

Q. And what was --

What brought you to R. J. Reynolds?

A. Well I enjoyed my job very much at Rohm & Haas. It was a very challenging job. But actually this is -- this is somewhat personal. My wife and I sat down at one point and tried to decide what was important in life and -- and we were just -- we just had our -- our first child a few years before that, and raising a family in Philadelphia wasn't particularly high on our list, so we tried to look around for places that we thought would be more conducive to raising a family in the way that we wanted to.

Q. Now what was your first position at R. J. Reynolds when you were hired into the research and development department in 1977?

A. My first position was a senior R&D chemist.

Q. And what did you do in that position, doctor?

A. Well I did a variety of things. I suppose most of my responsibilities were in -- in the area of filtration, how -- trying to understand how filters work, how to design new filters for cigarettes, trying to understand selective filtration. And

that -- that's a fairly complicated area that I suppose we'll talk about in a bit. But trying to understand selective filtration, how cigarette construction variables interact to influence the overall product performance.

I was involved in cigarette paper research, trying to understand how the properties of cigarette paper influenced the cigarette performance. There were a variety of things.

Q. Now in 1983 did your title change?

A. It did. In 1983 I was promoted to what's called master scientist.

Q. Did your duties change?

A. Well, I would say I received more duties. I still conducted research in the area of cigarette design and cigarette performance. In addition, I was given responsibility for directing the research of others, other scientists in the lab. So I suppose my responsibilities increased.

Q. In 1987, were you then promoted to principal scientist?

A. In 1987 I was promoted to principal scientist. And again my duties in the area of cigarette design didn't really change, there were just additional duties added on to it. In particular I was given

responsibility for larger research group, I was also given more responsibility for guiding and directing some of the research and development programs at R. J. Reynolds.

Q. The next promotion I have marked is in 1995 to senior principal scientist?

A. That's correct. In 1995 I was promoted to senior principal scientist, which is the top technical position at R. J. Reynolds. And in fact I was the first scientist promoted to that position.

Q. Did you get any new and additional duties at that time, doctor?

A. Once again, it just seems to add on more responsibility. But again, my -- my duties were still in the area of cigarette design. By that time I had gotten more into the applied product development end -- end of the -- the research and development department there.

Q. In 1996 did you receive another promotion?

A. I did. In 1996 I was promoted to director of product development and assessment.

Q. And your duties and responsibilities at that time were?

A. Well at that point my grew -- my research and development group actually grew quite -- quite large

and I took on a major responsibility in guiding and directing the work of that larger group, again in the area of cigarette design, but also now I took on responsibility for analytical chemistry research and providing analytical chemistry support for the company.

Q. And then in 1997, was there another promotion?

A. In 1997 I was promoted again, and this time to vice-president of product development and assessment, which is my current title. And in that job, with -- with that title, I'm responsible for product development for R. J. Reynolds, particularly focused on new product development, but also for modifications of existing products. I'm also responsible for all analytical chemistry research for the company, and I'm responsible for all routine analytical support for -- for the company.

Q. How many professionals are employed --

Well let me ask it this way first. How many people total are employed at the Reynolds research and development department?

A. In the research and development department right now there's about 450 staff.

Q. And how many of those people have advanced degrees of one type or another?

A. Well I can give you a very close approximation. I think it's somewhere in the neighborhood of 70 to 75 people have Ph.D.'s in science.

Q. Are there also other people who have master's?

A. There are. I suppose we have about 50 or 55 people that have master's degree in some form of science.

Q. What types of disciplines are these advanced degrees in?

A. Well there's a variety of disciplines. We have quite a few chemists, a few physicists, there are also biologists, toxicologists, there are --

And let me back up. In the -- in the chemists, we have a wide range of different types of chemists, including analytical chemists, biochemists, organic chemists, quite a few organic chemists, and a few physical/organic chemists even. But we span the spectrum of -- of many disciplines, including in the biological sciences as well as in the physical sciences like chemistry and physics.

Q. Now over the 20 years you've been employed at R. J. Reynolds, have you made presentations to professional and technical groups on matters relating to cigarette design?

A. I have.

Q. Have you been awarded any patents from the

United States Patent Office for your inventions?
A. I have.
Q. Are those inventions that are encompassed in those patents currently used in any commercial cigarettes sold by R. J. Reynolds Tobacco?
A. None of my patents are currently in use.
Q. And why is that, sir?
A. Well R. J. Reynolds, like any industrial company, tries to protect its intellectual knowledge, tries to protect -- protect what it -- what it knows in the form of patents, so even though the company is not currently using those inventions, we try to protect our competition -- or keep our competition from -- from actually using those ideas, and we do that by protecting it through patents.
Q. And the patents themselves are public documents once they're issued?
A. Oh, absolutely.
Q. Now are you a member of any professional organizations in your field, doctor?
A. I am. I'm a member of the American Chemical Society, which is the premier organization for chemists in the U.S. Most chemists, in fact, belong to this organization and it provides up-to-date

technical information through the perform of peer-reviewed journals, it also provides a forum for scientific exchange. And there are various national and -- and regional meetings of the American Chemical Society periodically.
I'm also a member of an organization called The Combustion Institute, and The Combustion Institute is a collection of chemists and physicists who are studying areas of combustion like -- well, trying to understand the detailed nature of flames, for example, trying to understand smoldering combustion, which of course is important in the area of cigarettes, trying to understand combustion in automobile engines, diesel engines and rocket propulsion. There's just a wide range of topics covered in combustion.
Q. Are you also involved in a group that goes by the acronym CORESTA, C-O-R-E-S-T-A?
A. Yes, I am. I am involved in a group called CORESTA. It's actually a French acronym. And it's -- it's an organization that's -- that spreads --
It's around the world. It's an international organization of tobacco scientists and scientists in related fields, so paper suppliers, filter suppliers

and -- and other scientists participate regularly in CORESTA.
The main functions of CORESTA are two-fold. First, to provide a vehicle by which we can come together, share scientific information and develop standardized test methods that the industry can use

around the world. It also provides a forum for scientific exchange. And once a year the scientists come from all over the world to CORESTA meetings and -- and share technical information.

Actually there's a third area that CORESTA is involved in, and that's, through task forces, trying to understand some of the problems of cigarette design or test methodology that's not proprietary, that doesn't cross into competitive issues.

Q. Is there a scientific commission at CORESTA?

A. There is. And actually this really gets into my involvement in CORESTA.

I'm involved in CORESTA in several ways. First of all, I'm presently task force chairman of a task force that's trying to develop a standardized test method for -- for what we call cigarette ignition propensity, and that's -- cigarette ignition propensity is the likelihood that a cigarette may start a fire if it's accidentally dropped on

upholstered furniture.

I'm also the vice-president of a scientific commission which is the main body that directs the scientific work of CORESTA. I'm also the president of one of the four major groups within CORESTA, which is the technology group. So I have a -- a lot of involvement in CORESTA.

Q. Have you been involved over the years in a group called The Tobacco Chemists Research Conference?

A. I have. For many years I've been involved in The Tobacco Chemists Research Conference. I think -- I suppose I have attended The Tobacco Chemists Research Conference for probably 15 years in a row, and over the last few years have not attended as much because -- because of time problems. Did attend the last one, however.

The Tobacco Chemists Research Conference is an opportunity for tobacco scientists and also scientists from suppliers or related fields to come together and share information about cigarettes, tobacco, cigarette smoke and the like. It's, again, primarily cigarette -- scientists from the industry, but there are people there from suppliers like Celanese, Tennessee Eastman. There are also scientists there from the universities, from

especially the University of Kentucky, the University of North Carolina. There are government scientists from USDA that regularly attend, scientists from Oak Ridge National Laboratory. Pretty much scientists that are interested in the area of tobacco and tobacco smoke.

Q. Do scientists from the American Health Foundation ever attend these meetings?

A. Scientists from American Health Foundation do attend regularly, they -- they rarely miss actually. Particularly Dr. Dietrich Hoffmann will attend that,

and he's been a long-time staff member and -- and actually a high-level staff member of the American Health Foundation. Sometimes colleagues, Klaus Brunnemann, who's an analytical chemist that I know well, and Marianna Dejorjvic also attends quite regularly.
Q. Are the proceedings of The Tobacco Chemists Research Conference published?
A. They are. The symposium proceedings have been published for a number of years, and our full-text papers of all -- of the -- manuscripts, really, of all the papers that are presented in the symposium.
Q. Have you been a presenter in the past at Tobacco Chemists Research Conferences?

A. I have. I have presented papers at The Tobacco Chemists Research Conferences.
Q. Now in the years you've attended and been involved in The Tobacco Chemists Research Conference, has a Professor Channing Robertson of Stanford ever made a presentation there on cigarette design or smoke chemistry?
MR. CIRESI: Objection, Your Honor, that's irrelevant.
THE COURT: Oh, you may answer that.
A. No, sir.
Q. Dr. Townsend, could you turn to tab one of your outline -- or of your book, and let me ask you whether -- that's Exhibit 0499A, and let me ask whether that lists several committees or working groups on which you participated with scientists outside R. J. Reynolds on cigarette design and smoke chemistry issues?
A. Yes, it does.
MR. WEBER: Your Honor, I'd move the admission for demonstrative purposes of Exhibit 0499A.
MR. CIRESI: I have 0499, not 0499A.
MR. WEBER: We sent you an A in the past few days. It had a date -- just one date change on

there.
MR. CIRESI: No. May I see it?
MR. WEBER: Yeah.
MR. CIRESI: No objection, Your Honor.
THE COURT: Is that A now that we're introducing?
MR. WEBER: 0499A, Your Honor.
THE COURT: Court will receive -- What's the X for, X0?
MR. WEBER: We marked our demonstratives with an X first, Your Honor.
THE COURT: Okay. X0499A will be received for illustrative purposes.
BY MR. WEBER:
Q. Dr. Townsend, could we start out with you explaining to the ladies and gentlemen of the jury

from the top to the bottom of the chart. Let's start with the 1987 entry for the Technical Study Group to the Interagency Committee for Cigarette and Little Cigar Fire Safety. Can you tell us what your involvement -- what it was and what your involvement in that project was.
A. The Technical Study Group was a group of scientists convened as a result of a congressional act, it was the Cigarette Fire Safety Act of 1984,

and the congressional act is a law actually directed to these scientists to come together from different fields and determine whether it's feasible, technically and commercially, to develop cigarettes that are less likely to start fires if they're dropped on furniture.
Q. Were --
Could you describe or explain some of the other representatives on the Technical Study Group. Was it only scientists from the tobacco industry?
A. No. In fact the tobacco industry scientists, I believe there were only four out of 15 total scientists. There were scientists from the National Institute of Standards and Technology, a government agency -- used to be called National Bureau of Standards. So there were experts in the area of fire and physics, fire physics, there were also emergency -- or fire scientists, people who understand fires and worry about fire suppression, there were also scientists from the National Cancer Institute. There was just a number of scientists from a variety of areas.
Q. Moving on to the next one, that references the Task Force on Cigarette Ignition Propensity for CORESTA. Is that a topic we covered just a few

moments ago?
A. Yes, it is.
Q. Let's go on, then, to 1990-1993, where it references a Technical Advisory Group to the Interagency Committee.
A. Yes.
Q. And I take it that's different from the first entry which referenced the Technical Study Group.
A. That's correct. The Technical Advisory Group was, again, convened by an act of Congress as a result of the 1990 Fire Safety Act. That Fire Safety Act directed the U.S. Consumer Products Safety Commission and the National Institute of Standards and Technology to do certain things, and one of the biggest jobs of this -- this task was that the National Institute of Standards and Technology was charged with developing a test method to compare cigarettes for the likelihood of -- of starting a fire.
The Technical Advisory Group included, again, like the other one we talked about, a group of

Commission.
Q. Dr. Townsend, will you go down to 1994 on the chart and reference the National Cancer Institute conference on the FTC test method. Could you again explain, first, what that conference was, then your involvement in it, and some of the others who were involved, if you could.
A. Yes. In 1994 -- and actually this conference was held, I believe, in December of '94 -- the Federal Trade Commission asked the National Cancer Institute to convene a panel of experts to consider whether the FTC test methodology for measuring tar and nicotine and carbon monoxide in smoke was -- was useful and if it needed be -- to be changed. So this conference was held and was organized by the National Cancer Institute, was held in '94, convened a group of scientists -- there was a panel of scientists who were charged with developing recommendations for the Federal Trade Commission, there was also a group of scientists who were invited to participate by giving presentations and also by participating in -- in the discussion back and forth about whether the Federal Trade Commission test method needs to be changed.
Q. And were you one of the outside experts invited to participate in the conference?

A. That's correct. I was invited as an outside expert, did provide a presentation, and did enter into scientific exchange and discussion throughout the course of that. I was not a member of the small group of scientists who were charged with developing the recommendations to FTC.
Q. Now was Professor Channing Robertson of Stanford either a panelist on the committee or an invited participant at the National Cancer Institute conference on the FTC test method?
MR. CIRESI: Same objection, Your Honor, it's irrelevant.
THE COURT: Sustained.
BY MR. WEBER:
Q. Let's move on, if we could, to the last one we listed there, Dr. Townsend, Canada's Expert Committee on Cigarette Modification. Again the same general question: Could you explain to the ladies and gentlemen of the jury what that committee was, who participated in it, and what your role was.
A. Yes. In 1996 the Canadian government convened a panel of experts to consider a number of topics, and all of those topics were around cigarettes and cigarette performance and in particular examined cigarette modification or changes that might be made

to cigarettes to reduce the risks of smoking. There were a number of issues, additional issues that were -- that were considered, including the importance of nicotine and the importance of a variety of other parameters about cigarettes. I was invited to -- to participate in that panel, along with a number of scientists from a number of groups or agencies or universities, and I provided, again, a presentation and entered into scientific exchange and debate.

Q. Let me ask about a few people, and if you could advise me whether or not they were also invited to join -- invited by the Canadian government to join this Expert Committee on Cigarette Modification, and I want to go through some names that the ladies and gentlemen of the jury have heard earlier in this case.

Was Dietrich Hoffmann invited?

A. Dr. Hoffmann was a participant.

Q. Was Dr. Henningfield, formerly of the National Institute of Drug Abuse?

A. Dr. Jack Henningfield certainly was.

Q. Dr. Neal Benowitz from San Francisco?

A. Dr. Benowitz was also.

Q. Dr. Shopland from the National Cancer Institute?

A. Yes, Don Shopland was there as well.

Q. Was Professor Channing Robertson of Stanford invited to attend?

MR. CIRESI: Excuse me, counsel. It's irrelevant who was there and who wasn't there. We'll go through all the conferences that Dr. --

THE COURT: You can testify --

MR. WEBER: Your Honor --

THE COURT: You can testify as to who was there; you cannot testify as to all of the scientists that were not there.

BY MR. WEBER:

Q. What did the --

Can you explain the proceedings of the Expert Committee of the Canadian government on cigarette modification.

A. Well this was, again, a committee that was commissioned by the Canadian government, so it was a legislative -- a legislatively created committee. We got together, shared information, shared a number of presentations on what we know about the risks of smoking, the epidemiology. We discussed the potential for cigarette modifications to possibly reduce the risk of smoking. We discussed the role of nicotine in smoking. We discussed the role of human

smoking behavior. And at the end of all of that, of course, there was no consensus about what all this

meant because there were a lot of different unanswered questions. For example, if one develops modified products that show reductions in certain biological tests or certain chemical tests, whether that constitutes progress in risk reduction.

MR. CIRESI: Excuse me, Your Honor, there's no foundation for this person to talk about safety or reduction, and there's no foundation for the hearsay that he's now testifying to.

THE COURT: Okay. It's certainly non-responsive, counsel. Why don't you ask him another question.

BY MR. WEBER:

Q. Did the Expert Committee issue a formal report to the Canadian government?

A. Yes, it did.

Q. And that's a committee you were part of; correct?

A. That's correct.

Q. Now has your education and Ph.D. in physical/organic chemistry been of relevance and assistance to you in understanding and designing cigarettes, Dr. Townsend?

A. Well it certainly has. My background and my training in physical/organic chemistry, I think, has given me the tools to conduct complicated experiments in the laboratory to try to understand the complex processes that occur in a burning cigarette. Very difficult both physically and chemically. The blend of physical/organic chemistry, I think, certainly has helped me. It also helped me in interpreting results from those experiments, in trying to understand the complex results and data that come out of those kinds of experiments.

Q. During your 20 years, have you conducted or supervised research and development activities in the following areas -- and rather than repeat the question each time, I'm just going to go through a series of areas with you, doctor.

I think you said you did for filters and filtration techniques?

A. Yes.

Q. Air dilution of cigarettes?

A. That's correct.

Q. Chemistry of smoke and formation of smoke?

A. That's correct.

Q. Physical properties and behavior of smoke?

A. That's right.

Q. Cigarette paper?

A. Yes.

Q. Materials development for new-technology products?

A. That's correct.

Q. New-product development in response to theories and suggestions from the external scientific

community?
A. Absolutely.
Q. Now has your work in cigarette ignition -- in the cigarette ignition propensity area been relevant to your study of cigarette design?
A. Oh, it certainly has. We've looked at -- at the possibility of reducing the risk of fire through cigarette design using many of the same design characteristics that we've studied so intensely. It is relevant.
Q. Has your education in matters relating to smoke chemistry and cigarette design continued over these 20 years at R. J. Reynolds?
A. Well it's been an ongoing process, that's for certain. One has to learn this field by doing it every day, by learning every day from the literature, both internal and outside literature, and -- and actually by conducting experiments. There are no

courses at the universities on cigarette design; one has to learn it on the job. And I have continued learning, as my staff has as well throughout the course of their -- their employment.
Q. You just mentioned courses and -- and the fact that universities don't have courses on that. Have you been given a responsibility from time to time by the R. J. Reynolds research and development department to develop and teach a course in cigarette design to other researchers at R. J. Reynolds?
A. Yes, I did develop a course in cigarette design. I taught it for a number of years. The last several years I haven't taught it, and in fact recently assigned one of my staff to revise that course and begin teaching it again to R. J. Reynolds.
Q. What period of time, what -- let me strike that. Let me ask it more directly.
For how long were you involved in the creation and the teaching of that course?
A. Well it actually took about, I would say, two and a half years to actually create the course because I was doing it pretty much on the side of my normal responsibilities. At the end of that, then I began teaching the course. The course changed over the years. I taught the course, along with one of my

colleagues, for about -- I would guess it would be about nine or 10 years in a row, and over the course of that nine or 10 years we kept changing it. The first time we taught it it was a 15-week course, either two or three days a week, usually, for 15 weeks. That turned out to be quite a lot of time away from normal duties for the staff, so we've gradually pared it down to where we taught it in either a three- or four-day, very intensive course with homework.
Q. Have you as part of your regular business activities in the R. J. Reynolds research and

development department become familiar with the research activities of research and development at Reynolds since the early '50s in the area of cigarette design?
A. Yes, I have.
Q. And smoke chemistry constituent analysis?
A. Yes. I've become familiar with a lot of the research at Reynolds from the time before I was at Reynolds. I think that's important. I certainly don't know all that's happened at Reynolds in the past, but -- but quite a large amount of the research I have had to dig into, both in the area of -- of smoke formation, how smoke is formed, filters,

cigarette construction, cigarette design, how to measure cigarette performance, the analytical chemistry of smoke, the analytical chemistry of other properties of cigarettes. It's --
Going back before my employment was -- was essential to learn what had been done before so that I wasn't going to repeat the same mistakes and experiments or -- or so I could learn from the failures of certain experiments and not -- not waste my time doing that. In some cases, some experiments that failed I did go back and repeat because maybe I had a better idea of how to do that experiment.
Q. Did you also --
As part of your regular business responsibilities in the area of cigarette research and design over these years, have you reviewed the external scientific literature regarding suggestions for and theories about what should be done to modify or reduce cigarette deliveries?
A. Absolutely.
Q. Why have you done that?
A. It's important to know in -- in the external literature also the various theories and approaches that people think might make progress in the cigarette design, so a large part of -- of -- of

product development and a cigarette designer's job is understanding the various theories, approaches, thoroughly understanding the cigarette performance, and -- and trying to understand the theories about how one might change cigarettes to address smoking-and-health issues, for example.
Q. Has this included a review of smoking-and-health literature, including suggestions and theories about cigarette design, the Surgeon General reports, and other literature?
A. I think keeping very closely abreast of -- of Surgeon General's reports, other smoking-and-health literature, is extremely important for scientists in the area of cigarette design and product development.
Q. Is the scientific literature on cigarette chemistry research and design limited to literature that's published in United States journals by United

States researchers?
A. No, of course not. There -- there's publications on cigarettes and tobacco smoke constituents and tobacco constituents from around the world. In fact one of the large peer-reviewed journals in the area of tobacco and tobacco smoke is -- is from Germany, Beitrage zur Tabakforschung.
Q. I won't ask you to repeat that. I'm not sure

what it was. You may have to spell that later for the record, though.
Have the suggestions and theories about cigarettes and the scientific literature had an influence on the course of cigarette design?
A. I'm sorry, can you repeat that?
Q. Have the suggestions and theories about cigarettes in the scientific literature had an influence on the course of cigarette design?
A. I believe they've had a very important and very direct influence on cigarette design. The theories in the smoking-and-health literature and the outside literature in general have -- have given us guidance on product-design modifications that may address a variety of issues on smoking and health. It also, the outside literature, I think, has affected consumer demand, because consumers are -- have also been aware of smoking-and-health issues and have actually driven the market to a large degree in demanding and wanting lower tar and lower nicotine cigarettes.
Q. Now in looking at literature, the theories and suggestions on cigarette design, how changes might be made, has Reynolds looked to theories and suggestions from researchers who are highly critical of tobacco

and tobacco smoking?
A. We have. We look at -- at the various theories regardless of -- of whether that particular scientist is critical of smoke or smoking. And in fact many of the critics that -- that we've looked at their theories, and many of the critics, frankly, that we have scientific dialogue with, believe that people shouldn't smoke.
Q. Have you and your colleagues at R. J. Reynolds also as part of your regular business activities attempted to keep abreast of cigarette design developments of other cigarette companies, both in the United States and abroad?
A. Oh, sure.
Q. Why have you done that?
A. Well to the best of our ability we try to understand what our competition is up to. It's important for us to compete very effectively with other cigarette companies. We try to do that through monitoring the patent literature, through monitoring what they publish and present at scientific conferences, try to understand exactly what their

capabilities are. We also go out into the marketplace and actually purchase their cigarettes, dissect them, try to understand how they're constructed, what the tobacco blend is like, what the paper and filter materials are -- are like, what the properties, both physical and chemical, are.

Q. On this same subject of the competition, do you and your colleagues at R. J. Reynolds in research and development become familiar with and use in the regular course of your business data regarding the market performance of R. J. Reynolds cigarettes as against its competitors?

MR. CIRESI: Your Honor, if we're going to start getting into more of an area of what the doctor does, I'm going to object to the leading nature now of the questions.

MR. WEBER: It's just for background, Your Honor.

THE COURT: All right. You can answer that.

THE WITNESS: Thank you, Your Honor.

A. Yes, we do in the research and development department, particularly in product development, in my area, keep up with market performance of the products that are actually in commercial market. And there are quite a few different products in the commercial market today, there are hundreds; we try to monitor their performance so that we can

understand how the cigarette's constructed, what the particular properties are of that cigarette, and also how it's doing in the marketplace. So we use both our internal market research information as well as -- most often, actually, we use external estimates of -- of market performance, for example the Maxwell Reports.

Q. Is the marketplace of ideas and innovation about how to improve or modify cigarette design, is that a marketplace limited to ideas or innovation developed in the United States?

A. I'm sorry, can you repeat that?

Q. I'm --

The question relates to the marketplace of ideas or innovation.

A. Uh-huh.

Q. Invention.

A. Uh-huh.

Q. Creativity about how to improve or modify cigarette design.

A. Right.

Q. Is that a marketplace of ideas only in the United States, or is it broader?

A. Oh, I see.

No, it's -- it's actually international. We do

look through products in the marketplace from around the world, we try to understand what scientists in the business around the world are doing, what they understand, what they know, what they're learning. We try to bring the entire international picture into what we do at R. J. Reynolds.
Q. Is the marketplace of ideas and creativity and innovation limited to ideas or innovation from cigarette companies?
A. No, it really isn't. There are a variety of ideas from private inventors, from other companies, as well as from the universities. We're constantly receiving ideas from all those people. There is also ideas that occur in normal scientific exchange with scientists from universities and other companies that are not our competitors.
Q. Have you and your colleagues over the years met with and had scientific discussions and exchanges with scientists and doctors outside the cigarette industry regarding the issues of how to modify and change cigarettes?
A. Yes, we have. An example is the Canadian expert panel that we've just already talked about.
Q. Now based upon your experience and the study and the work you've done at R. J. Reynolds over -- as

part of your general business activity for these past 20 years, are you generally able to discuss Reynolds' research and development activity over these years, including the scientific theories and reasons underlying the course of Reynolds' research and development?
A. Yes, I believe I am.
Q. Now in addition to that which you've learned and are familiar with as a regular -- as part of the regular course of business over the last 20 years, Dr. Townsend, have you also reviewed some additional materials in connection with your appearance here as an expert witness?
A. I have reviewed some materials, yes.
Q. Documents designated by the plaintiffs?
A. Yes.
Q. And have you reviewed parts of some of the testimony of prior witnesses?
A. I've reviewed some of the testimony of several witnesses. Certainly not a lot, but some.
Q. Now, sir, did plaintiffs' counsel in this case over the course of several days take more than one deposition of you in this matter?
A. Yes, sir.
Q. Was --

One of those depositions was as an expert?
A. I believe that's correct.
Q. And was one as a corporate representative of

Reynolds on facts and opinions known to Reynolds regarding research and development activities generally, and regarding nicotine in cigarettes and the design and manufacture of cigarettes?
A. I understand that to be correct.
Q. Now have you testified before before other courts and juries regarding the facts and opinions known to you, Dr. Townsend, regarding research and development in the areas of cigarette modification and design?
A. Yes, I have.
Q. And have you also testified based on the facts and information known to you through your regular course of business work over the past 20 years with Reynolds -- at Reynolds?
A. Yes, I have.
Q. Doctor, based on the background that you've described to the ladies and gentlemen of the jury, including your formal education, your training and experience, including in particular your experience and activities over the past 20 years for Reynolds R&D department, do you have an opinion to a

reasonable -- reasonable degree of scientific and professional certainty as to whether Reynolds and its major domestic competitors, Philip Morris, Lorillard, and Brown & Williamson, have researched, developed and put into the marketplace cigarettes that have responded to the theories and suggestions of the scientific community over the past 40 years?
A. I do.
Q. What is that opinion, sir?
MR. CIRESI: Objection, Your Honor, there's no foundation for that.
THE COURT: Sustained.
MR. WEBER: May I approach at side-bar, Your Honor?
THE COURT: Sure.

(Side-bar discussion as follows:)

(Side-bar discussion concluded.)

THE COURT: Counsel, will you be using that board for a while yet?
MR. WEBER: In a few minutes I will.
THE COURT: If we're not --
Then it's okay. I just think it blocks the view of some of counsel, and if it's not going to be used, we should lay it down. If it is going to be used, that's fine.
MR. WEBER: It's been blocking me for weeks there because I'm behind it.
THE COURT: I know. I would be very frustrated if I were looking at the back of a board myself.
MR. WEBER: Can I raise one quick issue?
THE COURT: Sure.
MR. WEBER: I'm sorry.

(Side-bar discussion as follows:)

(Side-bar discussion concluded.)

THE COURT: Ladies and gentlemen, we'll take a short recess.
THE CLERK: Court stands in recess.
(Recess taken.)
THE CLERK: All rise. Court is again in session.
(Jury enters the courtroom.)
THE CLERK: Please be seated.
THE COURT: Counsel.
MR. WEBER: Thank you, Your Honor.
BY MR. WEBER:
Q. Dr. Townsend, at the outset I think it might be helpful if you could explain how a cigarette works. Could you turn to tab two, which is X2472.
A. Yes, sir.
Q. Is that a chart that will help you explain what a cigarette is?
A. Yes.
MR. WEBER: Your Honor, I'd move the admission of X2472 for demonstrative purposes.
MR. CIRESI: No objection, Your Honor.
THE COURT: Court will receive X2472.
MR. WEBER: Your Honor, may Dr. Townsend come down and, with the board, explain to the ladies and gentlemen of the jury?

THE COURT: Sure, go ahead.
THE WITNESS: Thank you, Your Honor.
MR. WEBER: Your Honor, would you let me know, when I'm adjusting this, if I've got it in a way where you can see it also?
Is that all right?
THE COURT: I guess everybody can see it. Okay. Go ahead.
BY MR. WEBER:
Q. All right. Dr. Townsend, using what's been marked for demonstrative purposes as X2472, could you explain to the ladies and gentlemen of the jury the makings of the modern cigarette. And the only caution I give you is keep the sight lines in order, if you would.
A. I'll try.
Q. Thank you.
A. I'll be happy to try to explain this.
First of all, this is a cut-away of typical cigarette that's on the market today, and as you first look at it, of course it looks like a simple consumer article, however, the chemistry and physics of a burning cigarette is extremely complicated, very, very complex.
But let me first step you through the different

pieces so that we're together on terminology. Of course there's a tobacco blend in a cigarette, and it's usually a mixture of different types of tobacco, there's burley tobacco, which is air-cured,

flue-cured tobacco or Virginia tobacco, there's also some oriental tobacco, in some cases Maryland-grown tobacco, there's also reconstituted tobacco, expanded tobacco, and they're carefully blended in different proportions to yield the overall blend.

That blend, of course, is wrapped in a cigarette paper, and the cigarette paper is not just any normal paper, it's got carefully controlled properties, both thickness, porosity, the number of holes, the size of the holes that are in that paper.

If we turn our attention to the filter end of the cigarette, most filters in the United States are made of cellulose acetate. It comes from wood pulp which is then processed into a acetate form and then spun into fibers. Those fibers are gathered together in a bundle and they're wrapped with two pieces of paper. The first paper, which is an inner plug wrap, we call it, is actually a very, very porous, very thin paper, and its function is just to hold that bundle together, just to hold the fibers together. The plug wrap is a lot like tea bag paper, and in

fact some of the suppliers we use for this paper also make tea bags, so that will give you some idea of what that paper looks like and is.

The entire filter assembly, then, the filter plus this white plug wrap paper, is attached to the tobacco rod assembly by means of a tipping paper, and the tipping paper is the outer paper that's sometimes cork colored. It wraps around and is glued around the filter assembly and actually overlaps onto the tobacco rod usually three or four millimeters, and then it's glued. So it's the tipping paper that holds the tobacco rod assembly and the filter assembly together.

Q. Now Dr. Townsend, --

A. Can you see?

Q. -- let me hand you what's been marked as X2473 and ask if that's a demonstrative that would assist your testimony on how the cigarette burns?

A. Yes, it is.

MR. CIRESI: No objection, Your Honor.

THE COURT: Okay. That will be received into evidence for illustrative purposes.

MR. WEBER: Yes, Your Honor.

THE COURT: Okay.

BY MR. WEBER:

Q. Dr. Townsend, let me put up now what's been marked for demonstrative purposes as X2473 and ask you to explain to the ladies and gentlemen of the jury the nature -- nature of the burning cigarette and -- and how the system operates.

A. Right. As I said a minute ago, the cigarette looks like a simple consumer article; in fact, it's very, very complicated chemistry and physics once it's lit.

This is a depiction of a burning cigarette, and if you look, really, it's an expansion of just the front-end portion of the burning cigarette, so that's what we're looking at down here. If you look at what we've expanded, the cigarette paper char line or the front -- front edge of the cigarette paper is roughly here; the hot zone, we call the combustion region, is way up here, we sometimes call that fire cone; the tobacco rod of course is way back here.

Now once the cigarette is lit, temperatures can get quite high, and the highest temperatures during smolder are in the center of the fire cone and approach 850 to 900 degrees Celsius, which is maybe 14, 15 hundred degrees Fahrenheit, so it's quite hot.

As one puffs on the cigarette, air is drawn -- of course drawn into the cigarette, and it can't go

through the front end of the cigarette very well because this is such a hot region. Gases become very viscous and so there's a fairly high resistance to the flow of air down the front end of the cigarette. So where does the air come in? Well it comes in primarily in front of the cigarette paper, front edge, around the side or around the periphery of the cigarette.

As the air is drawn in during a puff, of course it's drawn into this hot region, the oxygen is burned and the resulting heated air is then drawn further down into the tobacco rod, down into here. The hot air, heated air then heats tobacco that's downstream up to the point of what we call pyrolysis. Pyrolysis is when you heat a material, particularly an organic material, to the point of its thermal decomposition, it undergoes massive degradation, it generates a lot of vapor-phase compounds that -- that then continue to be drawn down the tobacco rod.

Now as these vapors, these gases from the decomposition of the tobacco and the pyrolysis section continue down the tobacco rod, they cool, and as they cool they condense and form the smoke droplets. It's -- it's a lot like water vapor in the air, and then when the temperature changes that water

vapor condenses into fog droplets. So it's very much the same.

And the smoke actually, by definition, is a collection of both particles, and in the case of cigarette smoke there's the droplets, particles and the gas phase, and both together are smoke. So smoke is particulate phase, gas phase.

As the smoke carries down the tobacco rod during the puff, some of the smoke particulates, those particles, are actually physically trapped and removed by the tobacco shreads -- not a terribly efficient process, but it does happen. Also there's some of the vapors, instead of condensing into forming these droplets, will condense directly on the

shreads of tobacco. Light gas-phase molecules like carbon monoxide, nitric oxide and a few others, actually can diffuse out of the cigarette paper through these little holes fairly efficiently. Also during a puff on the cigarette fresh air is drawn in through these little holes. So you see, as the smoke is formed in this region -- which is not out in the combustion zone, smoke is formed back here -- as the smoke travels down the tobacco rod, it's constantly changing; some things are diffusing out, some gas-phase constituents are diffusing out, air is --

is being drawn in, there's some particulate phase being trapped on the -- on the tobacco. So it's constantly changing as the smoke moves down the tobacco rod.

Q. Now Dr. Townsend, you mentioned one term that I want to make sure we define clearly, and that was pyrolysis, and the reason is, there's been some testimony earlier in this case, and the question I want to ask you --

Is pyrolysis p-y-r-o-l-i-s-i-s? It's on there. Yeah, okay.

Is that different from combustion, from actually burning?

A. It's very different. In combustion, obviously a lot of heat is generated, it's oxidation of some material. And in this case, in the case of a cigarette, the combustion region is the oxidation of a carbonaceous char that's left over from the pyrolysis.

Let me take you through it in steps. If one heats tobacco to the point of major decomposition, this pyrolysis, all these gas-phase compounds come off as gas-phase compounds and you're left with a carbonaceous char residue, and it looks a lot like carbon but it's really not carbon per se, and it --

and that carbonaceous char, then, when it reacts -- or is exposed to oxygen, will burn very effectively -- very efficiently, generate a lot of heat. The pyrolysis itself takes heat, so you have to apply heat to cause pyrolysis to occur. Combustion, you get heat from it.

Q. Now with respect to the particulate- and gas-phase phases of smoke that you just referenced, I'd like now to put before the jury page 80 of what was previously admitted as PX3821, the 1989 Surgeon General's report.

Now this is a chart from, for the record, from page 80 of PX3821, from the 1989 Surgeon General's report, and it looks --

Maybe we ought to move that a little closer because of the detail on there, doctor. Okay. Can you help me? I still want His Honor to be able to see that.

All right. That looks pretty complicated. Can

you explain what that chart is for the ladies and gentlemen of the jury.
A. Okay. Is this still positioned okay?
Well it is a complicated chart, but let me step you through it so I can help make it a little clearer. This is -- what I'm trying to do is

describe -- and this is taken from the Surgeon General's report -- describe the composition of cigarette smoke, both the particular phase and the vapor phase. And remember I said that smoke is both together, that's what smoke is, gas phase and the particulate phase.
If we assume that a cigarette delivers about 500 milligrams of whole smoke, that's the total weight of everything that comes out the mouth end of the cigarette, and it's -- that total smoke is represented by the bar, this bar right here, and if we ask the question well what's that smoke composed of, it turns out that most of the weight is -- is compounds from air like nitrogen and oxygen. About 62 percent of the weight is nitrogen, about 13 percent of the weight is oxygen, four percent carbon dioxide, which of course comes from the combustion of the tobacco, there's a small amount of argon, which is a trace component of air, and about four and a half percent by weight is repres -- it represents the particulate phase, these little droplets that we talked about.
If we ask the question what's in the droplets, this four and a half percent, and we expand that out to this bar, then we see it's an extremely complex

mixture of many different constituents. And this just gives you classes of different types of constituents like -- well first of all there's about 16 percent water, typically, in the particulate phase, so that's 16 percent of four and a half percent; there's a class of compounds call carboxyilic acids, aldehydes and ketones, alcohol, nicotine of course, other alkaloids, esters, and a whole variety of constituents. And so, for example, carboxyilic acid approximately would be 13 percent of that four and a half percent. Very complex mixture.
Now if one asks the question what about the gas phase, we said that smoke is particulates and gas, we do -- we do the same thing and break apart the gas phase, we find that first of you will most of it is carbon dioxide, some from the air, a lot of it from the combustion of tobacco, there's again a small amount of gas-phase water, and there's about 10 percent or so of organic compounds in the gas phase. If we ask the question well what's in that fraction, we can break it apart again into a very complex mixture, some hydrocarbons, aldehydes, ketones, a number of different classes of compounds. But just say, for example, the aldehydes represent 20 percent

of that 10 percent of that 13 and a half percent.

Most of these constituents are present in very, very low levels, but a very complex mixture.

Q. Could you address that issue using whichever examples in there you would like, Dr. Townsend, that issue of what is the level of some of these compounds? I know you started out with the assumption on this chart of 500 milligrams. Could -- could --

Using one of these bars or the other, could you deal with the issue of the quantities we're talking about in this mixture?

A. Well I'll -- I'll try. If one takes the aldehydes, for example, that's 20 percent of 10 percent, so we're down to two percent; two percent of 13 percent would be about .3 percent roughly, of the total, if I've done my math right --

THE COURT: Excuse me, counsel.

THE WITNESS: Beg your pardon.

THE COURT: I wonder, as he's talking, if he could -- he's starting to talk on the chart and we're having some difficulty and the reporter is having some difficulty getting what you're saying.

THE WITNESS: Oh.

THE COURT: If you could --

THE WITNESS: Thank you, Your Honor.

THE COURT: -- turn somewhat so that -- we wouldn't want to miss any of your testimony.

THE WITNESS: Excuse me, Your Honor. I'll try speaking over here.

BY MR. WEBER:

Q. Dr. Townsend, what -- if we're talking about 500 milligrams, are all of these compounds and different types of groups we're talking about, are they also present in milligrams?

A. In milligrams? Well, not all of them. In fact very few are present in milligrams. Water, of course, is present in milligram quantities. Nicotine is typically present in tenths of milligrams, up to maybe one milligram quantity. Most of these constituents are present in extremely low levels, down to the microgram, which is a millionth of a gram, down to the nanogram, which is a billionth of a gram, and even lower. We're -- we're identifying constituents in smoke down to the -- to the picogram, which is a trillionth, and -- and even the femtogram range, which is a thousandth of a trillionth of a milligram per cigarette.

Q. All right. Thank you, doctor. If you could resume your seat now.

A. Okay.

MR. WEBER: Your Honor, would you like a copy of that? I don't know if you have one. I know that may have been hard to see. We may be past it now.

THE COURT: I would appreciate it, if you have one.

MR. WEBER: May I approach?

THE COURT: Please.

(Document handed to the court.)

THE COURT: Thank you.

BY MR. WEBER:

Q. Now Dr. Townsend, this chart from the 1989 Surgeon General's report cites its source as Dube and Green 1982.

A. Yes.

Q. Do you know who Dube and Green are?

A. Yes, I do.

Q. Could you identify them for the ladies and gentlemen of the jury.

A. Dr. Mike Dube and Dr. Charlie Green are both research scientists at R. J. Reynolds Tobacco Company.

Q. So the source for this information in the Surgeon General's report was what?

A. Drs. Dube and Green, both employees of R. J.

Reynolds. That research was conducted and that chart and that information in that chart was accumulated by R. J. Reynolds.

Q. We'll get back to that later. Let me just put that out of the way for now.

Dr. Townsend, is tar the same thing as smoke?

A. Well no, it isn't. Just a minute ago I was -- I was -- I hope I was making it clear that smoke is a collection of particulates, in this case the smoke droplets and the gas phase. Tar is just the particular phase trapped in some way, by some manner. So tar is represented by -- or -- yeah, tar represents the particulate phase.

Q. Using the FTC standardized test method, how much tar did the average cigarette on the market produce in 1955?

A. In the 1955, approximately 38 or so milligrams per cigarette tar.

Q. And how much tar, using the same measure, does an average cigarette on the market produce today?

A. The sales-weighted average in the U.S. today is just a shade under 12 milligrams per cigarette.

Q. Now you mentioned a moment ago a number of measurements that for non-scientists like me were a little hard to follow. I think we went from

milligram to microgram to nanogram. Start us out with a gram. About how much is a gram in a -- in reference to something we all might recognize?

A. A gram is about a 28th of an ounce. A number of consumer goods are measured out in gram quantities;

for example, like a pack of Equal is approximately one gram.
Q. And if we talk about that pack of Equal being approximately one gram, a nanogram would be how much of that?
A. A nanogram would be a billionth of that.
Q. Could you give me an example so that we might help visualize what a billionth is?
A. Sure. By my calculations, to try to help put this in perspective, by my calculations one part in a billion or one nanogram in a gram would be about the equivalent of a thickness of one piece of paper in a stack of paper about 63 miles long.
Q. Now let's talk a little bit about smoke constituents in some more detail, and I'd like to turn you to -- again to PX3821, the page 79 from the Surgeon General's report that's already in evidence. And if you'd look on the monitor --
MR. WEBER: May I approach, Your Honor, just to --

(Document handed to the witness.)
Q. Could you read the beginning of that second paragraph that I have highlighted there, doctor.
A. Just the highlighted portion?
Q. Right.
A. "In 1936 Bruckner listed 120 known components in tobacco smoke. This number grew to about 450 in 1959 (Johnstone and Plimmer 1959), to about 950 in 1968," and again there's a reference, "to 3,875 in 1972," the reference is Dube and Green, "and to 3,996 in 1988," reference is Roberts 1988.
Q. I think you said '72 for the Dube and Green reference, doctor.
A. It's 1982.
Q. Okay.
Now what's the number of compounds that have been identified in smoke that's known to science today?
A. Well this -- this reference says, "Today, the estimated number of known compounds in tobacco smoke exceeds 4,000...." Today we know of more than 4800, four thousand eight hundred components in tobacco smoke.
Q. Now if we start with that reference as to what was known in 1959, which is about 450 compounds,

known components in '59, we go to 950 in '68, and then to 3,875 as of '82, the number is obviously growing. Are there reasons as to why that number grew so exponentially?
A. Well it did grow very sharply, and I think the main reason that it grew so sharply is primarily the advance in analytical technology, analytical capabilities in chemistry. Back in the -- in the '30s, analytical techniques were extremely crude in chemistry. The '40s there was some improvement. By

the '50s analytical chemistry was still quite difficult, and separating compounds in a very complex mixture like tobacco smoke was extremely difficult.

As scientists have developed/invented new techniques for -- for analyzing chemicals in a very complex mixture, we've been able to see more and more constituents in smoke that are present in these very, very low levels, down into the billionths of a gram of milli -- billionths of a gram per cigarette and even lower. So it's clearly an advance in analytical technology that's allowed us to do this.

Q. Did it in the earlier days, let's say the '50s, did it take, using the methods then available, state-of-the-art methods then available, did it take large quantities of cigarettes smoked or collected as

tar to identify constituents?

A. Well that was one of the -- one of the problems. And probably I'll just give you an example, maybe to help clarify that, if I may. In trying to identify a constituent, benzpyrene, researchers at Reynolds had to actually smoke a large number of cigarettes, somewhere between 13 and 15 thousand cigarettes, collect all the tar from those 13 to 15 thousand cigarettes and try to separate. Now the -- the only technique at that time to do that kind of separation was a -- was a procedure we called liquid chromatography. In liquid chromatography you have a column that's filled with some kind of adsorbent. You place the material that you want to separate at the top of the column, you pour solvent down the column and wash this material down the column. And as the material travels down the column, you actually -- actually get chemical separation, because the compounds -- different compounds will move faster down the column than others.

So back to this example. We took the tar from 13 or 15 thousand cigarettes, or thereabouts, placed at the top of the column, and the column was three stories tall -- we actually built it in a stairwell and scientists were running up and down the stairs

pouring solvent in the top and collecting fractions out the bottom -- in order to separate and get enough material that we could identify benzpyrene.

Q. Could you talk about some of the improved analytical techniques that you reference, moving -- starting with the liquid column chromatography you just talked about.

A. Well liquid chromatography certainly was the key separation technique in the '50s. The '60s brought about a major revolution in chemistry through the invention of -- of gas chromatography. Gas chromatography then was a small instrument that had a very long column inside so you didn't have to build these large columns. They were miniature columns but extremely long. And -- and the scientists then,

using this bench-top apparatus, could separate complex mixtures a lot more effectively. You wouldn't need large quantities of material; sometimes the -- the tar from one or two cigarettes could give you enough information using gas chromatography. A very powerful technique for chemistry in general, not just for tobacco science.

Also a major advance in gas chromatography was glass capillary gas chromatography, and that's the type of chromatography most scientists use today,

most chemists use. And actually Reynolds was a pioneer in -- in the development of glass capillary gas chromatography. We worked with Professor Kurt Grob from Switzerland who was one of the main inventors of that technique, perfected it in our labs, and actually were way ahead of universities in using that back in the early '70s and mid-'70s.

Another powerful technique that we used is -- is the technique call mass spectrometry, and particularly mass spectrometry coupled with glass capillary chromatography is an extremely powerful technique for -- for detecting and identifying trace-level constituents in a very, very complex mixture. So we've had to develop and -- and in some cases, particularly in glass capillary GC, we've had to -- to provide some pioneering and analytical chemistry to do what we needed to do.

Q. Doctor, would you turn to tab four, which is Exhibit GJ100043.

A. Yes.

Q. Do you have it there?

A. Yes.

Q. Is that a 1967 textbook entitled "TOBACCO AND TOBACCO SMOKE" by Drs. Wynder and Hoffmann?

A. Yes. This is a textbook, and the title of it is

"TOBACCO AND TOBACCO SMOKE."

Q. Are you familiar with that textbook?

A. I am.

Q. Is that a textbook on which chemists interested in tobacco science reasonably rely?

A. It is. And in fact I consider it a desk reference for people interested in tobacco science.

Q. Have Drs. Wynder and Hoffmann been long-time critics of smoking?

A. Beg your pardon?

Q. Have Drs. Wynder and Hoffmann been long-time critics of smoking?

A. Yes, both of them have.

Q. Does the chemistry work and suggestions for modifying cigarettes nonetheless articulate theories and concepts on which you rely?

A. They do.

MR. WEBER: Your Honor, I'd move the admission of GJ100043 under 803(18).

MR. CIRESI: No -- no objection, Your

Honor.
THE COURT: Court will receive GJ100043.
BY MR. WEBER:
Q. Dr. Townsend, could you turn to page 428.
A. Yes, sir.

Q. And I'd like you to focus on that middle paragraph. And is there a reference there by Drs. Wynder and Hoffmann about work by the R. J. Reynolds labs?
A. Yes, there is.
Q. Could you read that for the ladies and gentlemen of the jury.
A. "The important contributions of the Research Laboratories of R. J. Reynolds Tobacco Company on the natural-occurring tobacco components and specific tobacco smoke constituents led to the isolation of a so far unknown group of lactones."
Q. Now down in the next paragraph, would you read that also.
A. Where the -- the paragraph --
Q. Beginning "Cook and Rodgman...."
A. Yes. "Cook and Rodgman (1962) isolated from the smoke condensate of 20,560 Turkish tobacco cigarettes by liquid partition and repeated column chromatography 259 milligrams and 20 milligrams of alpha- and beta-levantenolides, corresponding to 19 and 1.4 milligrams of I and II from 1 kilogram of tobacco smoked. Also Dickens and Black (1964) isolated these" two compounds "from cigarette smoke."
Q. Now Cook and Rodgman, are you familiar with

those scientists?
A. Yes, I am. Lawrence Cook was a scientist in the research and development department at Reynolds. Dr. Alan Rodgman was also a scientist in the research and development department at Reynolds.
Q. Does this book, "TOBACCO AND TOBACCO SCIENCE," have an author index, Dr. Townsend?
A. Yes, it does.
Q. Were you able to review that index to identify references to other Reynolds scientists?
A. Sure.
Q. Were there references?
A. Yes, there were dozens of references to Reynolds scientists.
Q. Does it also reference publications and contributions from scientists employed by other tobacco companies?
A. Yes, it does. Many.
Q. Have Reynolds scientists reported from time to time on discoveries and findings with respect to smoke chemistry at TCRC meetings, Tobacco Chemist Research Conference meetings?
A. Frequently they've presented scientific information on the identification of constituents in tobacco smoke at The Tobacco Chemists Research

Conference meetings. We've also presented that in peer -- a lot of that in peer-reviewed literature, we've presented some of it as CORESTA meetings. We've presented some of it at -- at journal of the -- at the American Chemical Society meetings in a variety of places; those meetings are held periodically both regionally and nationally. So we have presented and published the work, the results of constituent identification.

Q. Is it the practice in peer-review literature to report information that's already been reported by others?

A. No, in fact it's not the practice. Most journals won't accept information that's already been published for publication, and it makes sense. If -- if -- if one tries to publish information that's already known, you're not adding to the scientific body of knowledge, you're not advancing science by trying to publish something that's already published. So most journals don't accept that.

Q. Doctor, have all the components of cigarette smoke now been identified?

A. No, I'm certain they haven't. I think as analytical technology advances further, we'll be able to see more and more constituents. This is an

extremely complex mixture, no question about it, and I think the number of constituents that we know are present in cigarette smoke are solely dependent on our ability to find them as -- as analytical chemistry improves further.

Q. What levels or what quantities would we be looking at for these still-as-yet-unidentified components?

A. Well as I already said, we're -- we're measuring and quantitating constituents now in -- in the picogram range, which is a trillionth of a gram per cigarette. Analytical methodology, particularly mass spectrometry, is getting down into the femtogram range, which is a thousandth of a trillionth of a gram.

Q. Is the fact that cigarette smoke contains thousands of chemical compounds something that's unique only to smoke?

A. No, certainly not. I think many natural -- naturally occurring materials, whether it's leaves or foods or -- or many things, are extremely complex mixtures.

Q. Could you give the jury an example of a commonly consumed product that's made up of thousands of chemicals?

A. Well the first one that comes --

MR. CIRESI: Your Honor -- excuse me, doctor. It's irrelevant unless this is smoke that's inhaled.

THE COURT: You can answer the question.

A. The first example, of course, that comes to my mind would be something like coffee. I happen to be a coffee drinker, and there are thousands of constituents known in coffee.

Q. Are you aware, Dr. Townsend, of any substance from the analytical-chemistry standpoint that's been as intensely studied as cigarette smoke?

A. Well it's my opinion that cigarette smoke has probably been more intensely studied than other naturally -- or other materials, and it's, I think, because cigarette smoking is a risk for a number of diseases. I think there's been intense scientific research both within the tobacco companies and outside the tobacco companies to understand what -- what cigarette smoke is composed of and what tobacco is composed of.

Q. Doctor, I'd like to talk about some cigarette design issues now. I'd ask you to turn to tab five, which is X2485.

Is that a chart that will help you begin

explaining the design process?

A. Yes.

MR. WEBER: Your Honor, I'd move the admission for demonstrative purposes of X2485.

MR. CIRESI: No objection, Your Honor.

THE COURT: Court will receive X2485 for illustrative purposes.

BY MR. WEBER:

Q. Dr. Townsend, looking at X2485, could you explain to the ladies and gentlemen of the jury what you understand -- what you've defined as the elements of a product design process.

A. Yes, I'll be happy to.

There are a number of major pieces to how one goes about product development or product design, and the first is to clearly understand what the goal is, to -- to know what it is you're trying to accomplish, so the first is to define design goals.

Second, to assess the effect of each design choice; that is, to look how -- to look at how various choices of design may affect other characteristics of the cigarette, or -- or any product really. So I may make changes in one part of the cigarette that may affect the performance or the nature of the other part of the cigarette. So

essentially trade-offs.

The third is commercial feasibility or consumer acceptance. Very vital element in -- in product design process.

And technical and manufacturing feasibility, of course, is crucial, too. If you make changes to --

to a product design, you must be able to manufacture it and manufacture it reproducibly.

And then finally regulatory feasibility, the design must conform to whatever regulatory authorities look to.

Q. Now does this a design process -- I think you mentioned this, but I just want to make it clear. Is this a design process that applies generally in designing products?

A. I think it is a general process, not just one for cigarette product development. I think certainly new designs of automobiles, for example, would need to address every one of these. You'd need to know what the goal is, that's critical; you need to assign -- assess the effects of various design choices; it must be consumer acceptable to sell in the marketplace; it must be manufacturable; and it must meet some regulatory hurdles.

Q. Now focusing on that first step, designing

the -- or defining the design goal, could you give the jury -- just shorthands, and then we'll get into some of it later -- a description of some of the differing considerations or design goals in connection with designing cigarettes.

A. Well an example of some design goals for cigarettes might be, and probably an obvious one, to reduce the tar level. Another might be to reduce the carbon monoxide level, or to reduce tar, nicotine, and carbon monoxide level, and have a certain pressure drop or degree of difficulty of drawing --

"Pressure drop" is a term that we use in the industry -- let me back up for you -- which is essentially a measure of how hard it is to draw on the cigarette. A high pressure drop is very difficult to draw; a low pressure drop is easy to draw on the cigarette.

So one may look at any of those as targets, and there are actually quite many more.

Q. Going down to the second one, could you assess -- or give us an example of how you need to assess the effect of each design choice.

A. Well some of the examples I just gave you of goals, if there are multiple goals, for example, maybe -- maybe a product development challenge would

be to reduce tar and nicotine to a certain level and carbon monoxide to a certain level and maintain a certain pressure drop so that it's a consumer-acceptable product, and, you know, there may be multiple others. Having all of these design goals interacting may not be achievable, and so one always has to make trade-offs in -- in the development of consumer products, including cigarettes.

Q. How about commercial feasibility, consumer acceptance, how does that rank as a factor in design, particularly cigarette design?

A. Well in my opinion, being in this business for over 20 years, I think commercial feasibility or consumer acceptance is -- is the number one element, because if it's not marketable, if consumers won't accept it and it fails in the market, you -- you really haven't met your goals.
Q. Could you give the jury an example or two of cigarettes that represented good innovation but that failed to pass the consumer-acceptance test?
A. Yes. The first one that comes to my mind is -- is one that is -- was from R. J. Reynolds a number of years ago, and the name of the product was Premier. It was a product that didn't burn tobacco, it only heated tobacco. It was a revolutionary design, had

major reductions in many of the constituents that we've been talking about, it had substantial reductions in a number of biological tests, it had reduced environmental tobacco smoke. And it was unacceptable in the marketplace; consumers didn't like that product because of the very different taste, because it was difficult to light, it didn't burn down like a normal cigarette. There were a number of major differences. Consumers didn't -- didn't like that product.
A second example, one of my competitors actually, Philip Morris introduced a number of products that were so-called denicotinized, and they developed a process for removing nicotine from tobacco. This is a super-critical-fluid extraction process where they could remove almost all of the nicotine, and they got to very, very low levels of nicotine remaining in the tobacco. They marketed a number of products under several different brand names, there was a Next, there was a Merit denic, they also had several brand styles of Benson & Hedges that were denicked, and it -- it remained at similar tar levels, whether it be eight or nine or 10 milligrams tar, but it would be extremely low levels of nicotine, and those products failed in the

marketplace.
Q. Doctor, we will address the technical manufacturing feasibility and regulatory feasibility issues later.
Let me ask you this now: Were the suggestions and theories put forward by the external scientific community a factor in identifying design goals at R. J. Reynolds?
A. Yes, they've been a very direct factor in identifying design goals.
Q. Were those suggestions and theories consistent and uniform over the years?
A. No, they haven't been consistent. I think many people have -- have developed different theories on goals for modification of cigarettes, scientists have differing opinions, and -- and so I think there's --

there's been no consistent guidance. But there's certainly been guidance.
Q. Has the increasing number of identified constituents in smoke over the years affected cigarette design efforts?
A. Well it has, of course. The more we know about what's in smoke, the more theories are developed. Because as constituents are identified, some may be thought to be a problem or be responsible for the

risks of smoking, and the more we know about the chemistry, the more theories and approaches that have been developed. I think the more you know, the -- the more you have to do.
Q. Has the fact that R. J. Reynolds has taken the position that smoking has not been scientifically proven to cause disease stopped R. J. Reynolds and its researchers from looking for suggestions and theories from researchers who have been critical of tobacco and smoking?
MR. CIRESI: Your Honor, I'm going to object to the form of the question, it's leading and suggestive. We're into that area where he's eliciting opinions from the doctor.
THE COURT: Okay. I think it's time to get out of the leading area.
MR. WEBER: I didn't mean to. Let me see if I can phrase it differently, Your Honor.
BY MR. WEBER:
Q. In looking to the external literature, the theories and suggestions about how to modify cigarette design, has Reynolds limited in any way the literature it looks to?
A. No. We've had no limits to the literature we look to. And in fact we consider the theories that

are placed on the table regardless of where they come from, whether it's this country, overseas, whether it's people who are clearly against smoking, think people shouldn't smoke; we haven't limited those theories at all.
Q. Were there events in the early 1950s, doctor, that brought about a new or different focus in cigarette research and design efforts?
A. Yes, there were. There were two major events in the early '50s. In the early '50s, epidemiology began coming together after -- after a number of years and it became clear that cigarette smoking was a risk for lung cancer, and then subsequently it was clear that cigarette smoking was a risk for a number of other diseases. So the epidemiology really began coming together in the early '50s and was being published not only in the scientific literature but in the popular press.
The second major event in the early '50s was, after a number of scientists trying for years to generate mouse-skin tumorigenicity a reproducible

way, in a reproducible laboratory test, Professor Wynder, who was at Washington University in St. Louis at the time, produced the first successful mouse skin-painting test with cigarette smoke condensate,

and in that test, of course, he collected the tar, the condensate, and painted -- painted that condensate on the backs of mice and -- and saw excess tumors in that test. So that was the first successful test.

Both those happened in a short time, and I think were both key events in product development design.

Q. You mentioned Dr. Wynder before as one of the co-authors of "TOBACCO AND TOBACCO SCIENCE;" correct?

A. That's correct.

Q. The ladies and gentlemen of the jury have heard that name a number of times in connection with research. Could you just give a short biography of what Dr. Wynder's role in this area has been?

A. Well Dr. -- Dr. Wynder has devoted his -- virtually his entire career to the study of tobacco and tobacco smoke. Recently he's gotten into a number of other areas as well. But if I go way back, I think he's got expertise, certainly, in epidemiology and in biology. He's done quite a lot of tobacco and tobacco smoke research over the years while he was in universities, then when --

He was actually the catalyst behind forming the American Health Foundation where he is now currently director. So he's spent virtually his lifetime in

this area.

Q. Could you also just briefly describe Dr. Hoffmann, who is Dr. Wynder's co-author in that article. We've heard his name a number of times as well.

A. Yes. Dr. Hoffmann, Dietrich Hoffmann, is a -- is a -- is a chemist, scientist, who also has devoted his scientific career to the study of tobacco and tobacco smoke. Dr. Hoffmann actually I know because I've been on a number of panels. We have scientific discussions from time to time. I've presented data to Dr. Hoffmann. But he's -- he's certainly very knowledgeable and -- and actually contributed a lot to the scientific literature in not only smoke composition, but what that may mean in terms of -- of human disease.

Dr. Hoffmann as Dr. Wynder are certainly critics of the industry, but they're both good scientists.

Q. Based upon your review of the historic literature that you described, do you know what -- do you know whether Dr. Wynder and others took the position that the mouse skin-painting studies in the early '50s provided conclusive proof that cigarette smoking caused disease in humans?

MR. CIRESI: Your Honor, I'm going to

object to calling for a conclusion on the part of this witness.

THE COURT: Sustained.

Q. Without asking you for your opinion at all on this, Dr. Townsend, because it's not what -- not what I mean to impose -- include in this question, do you know whether Dr. Wynder and others, who had conducted those mouse skin paintings in the early '50s, whether they had expressed the view as to whether or not the mouse skin-painting tests were conclusive proof that cigarette smoking caused disease in humans?

MR. CIRESI: Again, Your Honor, it's the same question.

THE COURT: Sustained.

BY MR. WEBER:

Q. What are the issues or limitations, as you understand them, doctor, regarding extrapolation of the results in mouse skin-painting to humans?

MR. CIRESI: Objection, Your Honor, there's no foundation for this witness; doesn't have the qualifications on the biological side.

THE COURT: You'll have to lay foundation before he answers that.

BY MR. WEBER:

Q. Have you had, during the regular course of your

business over the 20 years at R. J. Reynolds, discussions with Reynolds scientists with advanced degrees in biological sciences about mouse skin-painting?

A. Yes, I have.

Q. Have you needed to learn about mouse skin-painting to some degree in connection with product development activity?

A. To some degree I do -- I do have to learn about mouse skin-painting as well as certain other biological tests. That doesn't make me an expert, but I have some knowledge of those tests.

Q. And just for your understanding, could you let us know what your understanding is about the limitations of extrapolating the results of mouse skin-painting to humans?

MR. CIRESI: Your Honor, there's no foundation. It's simply --

He's already just said he's not an expert. He'd have to bring in someone from Reynolds who has that knowledge.

THE COURT: Sustained.

BY MR. WEBER:

Q. Did these studies in the early '50s, particularly the mouse skin-painting studies, have an

effect on cigarette design and research at Reynolds?

A. Yes, they did.

Q. Could you explain that.
A. The mouse skin-painting studies that did produce excess tumorigenicity or excess tumors had a direct influence on the research at Reynolds because it really began the intense drive on cigarette design modifications. It led to trying to understand and -- and looking to the scientific -- the rest of the scientific community as well for the theories that may be responsible for why that occurs, and trying to understand the composition of smoke, and trying to understand how cigarette design modifications could affect that.
Q. What approach or approaches did R. J. Reynolds follow at that time?
A. There were two general approaches we took in cigarette design to try to address --
Q. Dr. Townsend, I'm sorry, let me interrupt you, because I want to write these on the chart. I don't want to --
A. Okay.
Q. I'm sorry to interrupt. You were talking about the approaches --
A. Right.

Q. -- that R. J. Reynolds took in its research and development as -- in response to some of these scientific studies in the '50s.
A. Right. There were two general -- two overall approaches that we took to cigarette design modifications. The first is selective reduction of smoke constituents and -- and the second is general reduction of smoke constituents, and we conducted both of those approaches to address smoking-and-health issues.
Q. Could you just briefly -- because we're going to describe both of these approaches in some detail, doctor -- could you just briefly describe the theory or approach represented as selective reduction and then the theory or approach described as general reduction.
A. Sure. Selective reduction -- and let me back up.
If you remember, cigarette smoke is a very complex mixture. I keep saying that. The idea behind selective reduction is to somehow go in and pick out one compound and reduce it or eliminate it, or one class of compounds, reduce it or eliminate it, with the thought that that compound or that class of compounds might be responsible for the risks of

smoking. So it's to take the complex mixture, go in essentially with a scalpel and somehow cut out the problem compound or compounds.
General reduction is an approach of reducing all of the constituents in smoke more or less to the same degree. That's why we call it "general reduction," so all -- all constituents are reduced.

Q. Were these approaches explored by Reynolds at the same time or at different times?
A. Selective reduction and general reduction both were explored simultaneously, at the same time, and both began at Reynolds in the early '50s.
Q. And how long has Reynolds been exploring both of those methods?
A. We are exploring and doing intensive research on both even as we speak.
MR. WEBER: Your Honor, I'm about to move into a good deal of detail on selective reduction. Is there any chance we could end a little early so I could have Dr. Townsend tell that story all at once?
THE COURT: Pretty good chance.
(Laughter.)
THE COURT: Why don't we recess and reconvene tomorrow at -- well Monday morning.
(Laughter.)

THE CLERK: Court stands in recess, to reconvene Monday morning at 9:30.
(Recess taken.)